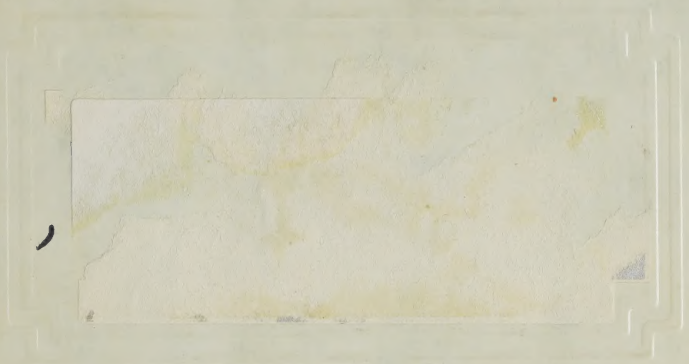

UTILIZATION OF SPECIALIZED MANPOWER IN CANADA

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The importance of people with specialized training to the growth of the Canadian economy could hardly be over-emphasized. You are no doubt familiar with the vast industrial expansion that has been occurring in Canada during recent years. In great measure the development of natural resources and manufacturing in Canada is a product of the technical contributions of a very specialized group in the labour force, the scientists and the engineers. We have always had our oil resources, our base metal and iron ores, our uranium and titanium, but it was only when the scientist, the engineer, and the other personnel associated with them had worked out methods of finding, processing and distributing these resources in an efficient way that their full economic potential was realized.

I do not want to create the impression that the scientist and the engineer are virtually new species which have just appeared on the Canadian scene. This is far from the truth. Although their numbers have increased at an exceptional rate since 1939, even in 1901 there were about 3 engineers in our labour force for every 1,000 non-agricultural workers. Today, there are over 8 engineers for every 1,000 non-farm workers.

I am first going to discuss some of the ways in which our pool of scientists and engineers has been built up. I intend to turn then to a consideration of the ways in which this pool has been used while doing that, and outline some of its characteristics as they exist today.

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Finally, I want to deal with Canada's current requirements for these kinds of specialized workers, and review some of the steps that are being taken in Canada to assure that our continuing needs are met.

The Supply of Technical Personnel in Canada

What is the extent of Canada's resources of specialized manpower? As you know, keeping a completely accurate record of manpower resources is not an easy task. However, the Canadian Department of Labour has maintained a roster of technical and scientific personnel on a voluntary response basis since the end of the Second World War. This grew out of the Register which was maintained during the war years. In the last $2\frac{1}{2}$ years about 70 per cent of the individuals who were asked to do so have returned completed questionnaires.

This information provides a basis for making estimates of the number and characteristics of technical people in Canada. The figures resulting from these estimates are shown in Table I. Of the 59,000 technical persons, approximately 35,000 are engineers. This table also shows the types of specialized manpower on which we have information. Table II shows the university enrolment and graduates in engineering over a period of 35 years. This table also points to the fact that the number of graduates in engineering was especially high in the three years 1949, 1950 and 1951, when large numbers of war veterans were graduating.

The principal source of specialized manpower is found in the graduating classes from Canadian universities. The number of graduates is sharply affected in turn by university enrolment, which is dependent both on the total number of young people within certain age groups in the country and on the proportion of these who decide to continue their studies after finishing high school.

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There are today actually fewer people in Canada between the ages of 15 and 19 than there were in 1939. This is due largely to the lower birth rates during the depression years of the thirties.

There will not be much increase in either the 15-19 or 18-24 age groups until 1955. Over the next few years, therefore, university enrolment is not likely to be affected much by an increase in the number of young Canadians of the appropriate age.

This means that any change in enrolment will be due largely to a change in the proportion of young people going to universities. It is impossible to tell exactly what the future trend will be but it is of some interest to compare the percentage increase between 1921 and 1951 in enrolment in institutions of higher and secondary education with the percentage increase in the total population of the relevant age groups.

The total population of the age group 13-17, the ages when most Canadians receive their secondary school education, increased between 1921 and 1951 by about 29 per cent. Meanwhile, total attendance at high schools and other institutions of secondary education is estimated to have increased by about 150 per cent.

For college and university education, the relevant age group is approximately 18-22. The total population of this age group increased between 1921 and 1951 by about 45 per cent. Enrolment of full-time undergraduates in institutions of higher education increased, during the same period, by about 175 per cent. According to projections made by the Canadian Department of Labour, the number of students going to Canadian universities will continue to increase in the years ahead.

There is also a trend toward more graduate work in Canadian universities. The staff and facilities for graduate study in most disciplines in Canadian universities are, however, still limited. For opportunities in

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graduate study in all fields of learning, Canadians are considerably dependent on the United States and Great Britain for providing university facilities and, in addition, scholarships and fellowships.

As the Report of the Royal Commission on National Development in the Arts, Letters and Sciences points out, Canada has, however, had to pay rather dearly for this dependency. The Report says:

> "Canada has, ..., paid a heavy price for this easy dependence on charity and especially on American charity. First, many of our best students, on completing their studies at American institutions, accept positions there and do not return. The United States wisely relaxes its rigid immigration laws for all members of 'learned professions' and profits accordingly ....."

Immigration has, of course, helped offset the loss to Canada of professional personnel through emigration. In the postwar years, especially, Canada has been able to supplement its supplies of technical manpower by immigration from other countries, but immigration is likely to supply a relatively small number of professional workers compared with those who receive their basic training in Canadian universities. While immigration and emigration figures are not available in detail, it would appear that Canada has made a slight net gain since the war. Furthermore, fewer Canadian engineering graduates may be emigrating to the U.S. than is generally understood. According to information obtained from four leading Canadian universities, less than one per cent of the engineering graduates from those universities went to the U.S. in 1951.

Utilization

I would now like to take a closer look at some of the more important characteristics of the Canadian resources of engineers and scientists. Table III was prepared in our Technical Personnel Section from the punch cards of those who stated they were especially qualified in the professional groups listed in the table. Most, but not all, have academic training in the field

where they are now qualified. Graduates of 1951, 1952, and 1953 are not included because we do not ask new graduates to complete questionnaires until three years after they have left university.

Let us review some of these characteristics. Under the heading of training level it is significant that practically all those in physics, geology and biology have graduated from university. The percentages holding a bachelor's, master's or doctor's degree are also fairly comparable for each group. It would therefore appear that post-graduate study should be considered by persons intending to follow these professions.

In the civil, electrical, mechanical and the mining and metallurgy groups, between eight and ten percent have never attended university and an average of three per cent attended but did not graduate. The numbers holding a bachelor's degree are much the same in each group, being close to 80 per cent, and the number with a doctorate is under one per cent except in mining and metallurgy, where it is 2.4 per cent. The training level of the chemistry and chemical engineering group lies between the scientific and engineering groups.

Looking at age characteristics, it will be noticed that very few fall between 21 and 25. This is because none of the classes of 1951 or later are included and very few of the 1950 class have yet been put on punch cards.

If a line is drawn at age 50 we find that the percentage over this age is, for civils 35, electricals 21, mechanicals 21, mining and metallurgy 23, chemistry and chemical engineering 11, physics 6, geology 14, and for biology 13. Thus civil, the oldest branch of engineering, is weighted most heavily with those in the older age brackets, and physics, in which such great advances have been made in recent years, shows the reverse pattern.

Under "function" you will see that over half of those in biology are especially competent in research, compared with approximately two-fifths of those in physics and one-fifth for geology and chemistry and chemical

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engineering. The other groups show small percentages in this respect. Designing and draughting has the largest percentage of experts in the civil group, followed by the mechanicals and electricals, with very small numbers for the other groups.

Construction predominates in the civil group. The biologists have 24 per cent in teaching, extension work and writing; the figures are 19 per cent for the physicists and 13 per cent for the geologists. The other groups show much smaller percentages. The geologists have the largest percentage in consulting work. This is to be expected, as many are self-employed and much geological work is being undertaken today in Canada.

With regard to type of employer, 37 per cent of the civils are with the four branches of government service listed. The electricals are mainly with manufacturing concerns or public utilities, 63 per cent being thus employed. Manufacturing employs 69 per cent of the mechanicals, and this percentage is just about matched by the chemistry and chemical engineering group. The fairly high percentage of the mining and metallurgy group employed by manufacturers would be partly accounted for by metallurgists in establishments making various metal products.

About two-thirds of the physicists are employed by the federal government or the universities, and the same is true for the biologists. In the geology group, of the quite large percentage listed as being now employed by manufacturing firms, over two-thirds are with companies manufacturing products of petroleum and coal, and they would be employed at geological work.

The information given in Table III shows how a large percentage of Canada's technical and scientific manpower is being utilized today, and I think you will find it quite an interesting document to study.

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It has been estimated that about one-quarter of all technical persons in Canada are on the payroll of only 25 employers. The Government of Canada is, of course, the largest of these. Included in the 25 are several large public utilities (transportation, communication, electric light and power), two of the provinces, the National Research Council, one university and manufacturing organizations in some eight different fields. By extending the list of employers to 200, well over half the technical personnel would be covered. This is an important factor in assessing the problem of supply and demand and related matters. Trends which concern this comparatively limited number of employers can be taken as broadly typical for the whole group, even though more and more small firms are employing university graduates.

The current preparedness effort must be mentioned in connection with the requirements for university-trained personnel. Many highly trained people are required in planning, designing, producing and operating the complex defence equipment and facilities of to-day. The need for such people in the Services, particularly the expanded work of the Defence Research Board, in the National Research Council, and in other related government agencies has increased greatly.

The National Research Council is an important research organization, and also co-ordinates much of the scientific research done in Canada. During the Second World War it was responsible for military research. On the advice of the Council, the Government set up in 1947 the Defence Research Board, whose responsibility it is to conduct and direct research relating to military projects.

For the current fiscal year the budget for the National Research Council is $14,500,000. There are approximately 2,000 employees. Of these, 535 are designated as "scientific personnel" and another 679 persons are classified as "technical personnel". In addition to the regular staff of the Council, much

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research in the natural sciences is done by university staff and students receiving financial assistance from it. The number of scientific persons employed by the Defence Research Board increased from 225 in March, 1950 to 481 in March, 1953 and its expenditures increased during the same period from $9\frac{1}{2}$ to $23\frac{1}{2}$ million dollars.

Requirements and How Dealt With

To secure some indication of the probable future requirements for professional personnel, the Department of Labour asked a large sample of employers in all regions in Canada during the summer of 1952 what they expected their requirements to be for university-trained personnel over the coming four years.

The results of this survey suggest that, in general, the labour market outlook for university graduates is one of fairly close balance, with some shortages in certain categories and small surpluses in a few others. This, of course, assumes that present expansionary trends in the economy will, by and large, persist over the period.

The analysis of the returns shows, first, that shortages are more likely to occur in engineering than in any of the other professions. Secondly, it is chiefly the large employers who anticipate difficulties in meeting their requirements for professionally-trained people.

It is generally agreed that Canadian universities have played an important part in providing specialized manpower in Canada. Unlike Britain, Canada has not the technical schools and system of apprenticeship that offer alternative training for such professions as engineering. Our method of training technical personnel has been more like that of the United States, university courses of training for the professions. Despite the recognized importance of universities in Canada, they have done their work under a difficult

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financial handicap for many years. This has resulted in over-crowded classes, sometimes inadequate equipment and onerous work loads for teaching staffs. According to a recent statement made by the Principal of McGill University, during the 12-year period from 1938 to 1950, the national income of Canada increased three and one-half times, but the total endowments of Canadian universities increased only two and one-tenth times. The physical plant and equipment of Canadian universities, the buildings, laboratories and libraries that are essential for higher education in the modern world were only one and two-thirds as large in 1950 as they had been in 1938, although the number of students attending Canadian universities had tripled. Despite many difficulties, Canadian universities have, nevertheless, continued to train increasing numbers of much-needed technical personnel.

Using the 1951 census as a basis for its estimates, the Canadian Department of Labour has estimated that the total number of students going to university will continue to increase and there will be over 58,000 in 1961 compared with 50,580 at the time of the 1951 census. It should be remembered that this estimate for 1961 is made without taking into account immigration, emigration, or other factors which do not lend themselves to assessment on a mathematical basis.

Industry and the engineering profession have taken steps to publicize the existing and prospective needs for engineers and scientists. They have made counselling services available to potential students, and they have taken stock of existing professional staff with a view to more efficient utilization, such as withdrawing them from duties which can be performed, for example, by technicians without professional training.

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Early in 1951, a National Advisory Council on Manpower was established to advise the Minister of Labour on matters relating to the most effective utilization in the national interest of present and potential manpower of Canada.

The Federal Department of Labour has developed a student-aid program in co-operation with the provinces, and makes occupational information relating to the professions available through the school systems and other counselling channels. The Technical Personnel Section of the Department maintains close contact with universities, professional organizations, some of the larger industrial concerns, the National Employment Service, the National Research Council, the Defence Research Board, and other government agencies to which the Register can be of service or from which co-operation is obtained. A Quarterly Bulletin is issued which helps to provide educational institutions, industry and government groups with current data and analyses of demand and supply trends for specialized personnel.

I think it is generally realized that technical and scientific personnel are not all being utilized to the best advantage in Canada. This applies equally to government and industry. Certainly the increasing complexity of engineering products, particularly in the electrical and mechanical fields, makes it desirable, if not essential, to have graduate engineers looking after sales and service, but it is a fact that much of the sales work which such persons are doing could be carried out just as effectively by individuals without high technical qualifications. There has been talk of stock-piling graduates on the part of some firms in order to be prepared for future requirements. Others are reported to engage more than they need in order that the best can be selected and retained.

Many engineers and scientists are in administrative jobs where their training is not utilized fully. There are significant differences, of course, depending on the type of engineering. The tendency to work on administrative

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jobs may be particularly unfortunate in the case of some younger persons who thus have no opportunity for the true practice of their professions. It is, of course, to be expected that many technical persons will work in managerial and administrative capacities as they progress in their work.

Shortages, as you all know, can be relieved by the better utilization of existing technical personnel as well as by increasing their numbers. The increased attention being paid by engineers and by personnel officers to labour utilization is helping to meet this situation. The larger number of university graduates, trained in commerce, business administration and industrial relations, will no doubt also reduce some of the pressure now placed on engineers.

Some efforts have been made in Canada to train technicians within industry and in schools who can take over some of the work being done by technical personnel. Each of two provinces operates a technical institute which is more or less on the junior college level. In them people are trained to a quite high degree of professional skill in various branches of engineering as well as in other fields. Enrolment figures for the past four years indicate the increasing popularity of this training. In one of these institutions enrolments have almost doubled over the past three years.

The institutions just mentioned provide graduates who can take over duties that would usually have to be performed by professionally qualified personnel.

Within industry efforts have been made to develop the more highly-skilled technicians in order that they may relieve the stress on professionally-qualified people. From Table III you will see that, of the individuals registered with our Technical Personnel Section, 15 per cent of the civil engineers,

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12 per cent of the mechanical engineers, 10 per cent of the electrical engineers, and 11 per cent of the mining and metallurgical engineers are not university graduates. These percentages indicate the possibility of increasing the supply by other means than university graduation.

In a period of national emergency, scientists, engineers and other related technical personnel assume a key role, not only in the direct prosecution of the war, but in essential production activities associated with it. For this reason it is important that technical personnel be carefully allocated to essential uses and that the supply of new graduates be maintained at reasonably adequate levels.

Our Technical Personnel Register was first put into operation in 1941, when it had become evident that some regulation of the employment and movements of technical and scientific persons was necessary for the effective prosecution of the war. The work of developing the register was accomplished with the assistance of the various professional groups and the universities. In the early part of the war attention was directed to determining the number of technical persons and where they were most required in the war effort, and in assisting them to find essential employment. Later on it was necessary for persons who qualified as technical personnel to secure a permit from Selective Service before undertaking new employment.

During the war the call-up of professional, technical and skilled men was postponed if they were officially certified as being engaged in work which was in the national interest or essential to the prosecution of the war.

Full-time college and university students in arts, science or commerce or other courses which were in the national interest could have their military training postponed, provided they passed their examinations and enrolled

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in the Officers' Training Corps. Graduate students were allowed to pursue their studies provided such study was designated as contributing to the prosecution of the war.

In 1944 the courses considered to be contributing to the prosecution of the war or in the national interest were designated as: Medicine, Dentistry, Engineering or Applied Science, Architecture, Commerce, Agriculture, Veterinary Science, Forestry, Pharmacy, Education, and specialized courses in Mathematics, Physics, Chemistry, Biology or Geology. Students in other courses than these were not drafted provided they were in the upper half of all the students enrolled in the same academic year as determined by the final examination.

This policy of maintaining students in essential courses in university provided a continuing increment, throughout the war, to the technical manpower group, and also tended to alleviate the shortages which have characterized the postwar years.

Our present Register contains the records of nearly 29,000 persons on punch cards and the records are being kept up to date and extended. They provide background data useful for emergency manpower studies and can also be used as the basis for a wartime register in the event that we again became involved in a world conflict.

The Future Outlook

What about the future? If Canada is to continue her technological and economic progress, it will be necessary to increase the supply of technical and scientific manpower, utilize this manpower in the most effective manner, and ensure that professionals are kept in useful employment as long as possible. The Canadian Government is already supporting universities financially and offering assistance in various ways to university students. Scholarships are

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being provided on an increasing scale. There are fewer young people today going without a university education for financial reasons than in earlier years, but it is still undoubtedly a factor in many areas. There is also need for additional financial support to universities so that they can expand their facilities thus removing any possibility of lowering the quality of instruction as a result of over-crowding and inadequate staff and equipment. So far as students are concerned there is evidence that they will increase in number as time goes on. At present the number of young people reaching university-entering age each year is low and will likely remain low until 1956 when it is expected to reach 870,000 and then to increase to 1,000,000 by 1961. The opportunity for employment, which has been particularly good for youths during recent years in Canada, is, of course, an important consideration here. There are likely, however, to be increasing efforts made by industry and the governments to ensure that young people in secondary schools are given full information about professional possibilities and how to obtain a university education.

More attention will also need to be paid to the utilization of technical and scientific manpower. The percentage of some groups which Table III shows as being employed in sales, service, administrative and supervisory capacities suggests that reductions might be made, particularly under emergency conditions. There should also be an increase in the number of technicians trained in industry and technical institutes to relieve professionaly qualified persons.

While it is not possible to make a statement which is applicable to all groups it seems likely that if we can ensure careful utilization, adequate training facilities, energetic counselling in secondary schools and a reasonable volume of immigration, the supply of technical and scientific manpower will approximately meet the demands of Canada's rapid development under peacetime conditions.